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(54) Methods of fabricating a page wide piezoelectric ink jet printhead assembly

Herstellungsverfahren eines seitenbreitigen piezo-elektrischen Farbstrahldruckkopfes

Méthode pour la fabrication d'une tête d'impression par jet d'encre piézoélectrique ayant la largeur d'une page

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Description

The present invention relates generally to ink jet printing apparatus, and more particularly relates to the fabrication of piezoelectrically operable ink jet printhead assemblies.

A piezoelectrically actuated ink jet printhead is a device used to selectively eject tiny ink droplets onto a print medium sheet operatively fed through a printer, in which the printhead is incorporated, to thereby form from the ejected ink droplets selected text and/or graphics on the sheet. In one representative configuration thereof, an ink jet printhead has a horizontally spaced parallel array of internal ink-receiving channels. These internal channels are covered at their front ends by a plate member through which a spaced series of small ink discharge orifices are formed. Each channel opens outwardly through a different one of the spaced orifices.

A spaced series of internal piezoelectric wall portions of the printhead body separate and laterally bound the channels along their lengths. To eject an ink droplet through a selected one of the discharge orifices, the two printhead sidewall portions that laterally bound the channel associated with the selected orifice are piezoelectrically deflected into the channel and then returned to their normal undeflected positions. The driven inward deflection of the opposite channel wall portions increases the pressure of the ink within the channel sufficiently to force a small quantity of ink, in droplet form, outwardly through the discharge orifice.

Under previous methods of constructing piezoelectric ink jet printheads the printhead body section in which the channels are to be formed is first poled, to make it piezoelectrically deflectable or "active", by imposing a predetermined voltage widthwise across the body section in a selected poling direction parallel to the desired piezoelectric deflection direction of the internal sidewall sections to be later created in the poled body section by forming a spaced series of parallel grooves therein. These grooves may be formed using a sawing, laser cutting or etching process.

A typical material used in the formation of piezoelectric ink jet printhead bodies is a piezoceramic material- commonly referred to as "PZT." The proper poling of PZT requires voltages on the order of $1.18 \cdot 10^3$ to $2.9 \cdot 10^3$ volts per mm (30 to 75 volts per mil). Accordingly, the widthwise poling of a 25.4mm (one inch) wide printhead body section formed from PZT requires a poling voltage within the range of from about 30,000 volts to about 75,000 volts.

This poling voltage requirement has resulted in limiting the manufacturable width of a PZT ink jet printhead body, in a direction perpendicular to the ink discharge direction of the printhead, to about one inch since an appreciably wider PZT body section requires unacceptably higher poling voltages. For example, a ten inch wide PZT body section would require a poling voltage somewhere in the range of from about 300,000 volts to about 750,000 volts. Even if this much wider PZT body section could be properly poled at this extremely high voltage, the interior sidewall actuator sections ultimately formed from the poled section would normally exhibit the undesirable tendency to crack when piezoelectrically deflected during operation of the finished printhead.

This PZT printhead body width limitation has resulted in the inability to manufacture piezoelectric ink jet printheads in full page widths - i.e., in the 21.6 to 27.9cm (8.5"-11") width range. This necessitates the shuttling back and forth of a small width piezoelectric printhead across a print medium sheet interiorly traversing the ink jet printer, as opposed to the desirable alternative of forming the printhead in a page wide width which would permit the printhead to remain stationary during the ink jet printing process.

It would thus be desirable to provide methods for fabricating a piezoelectric ink jet printhead in a page wide printing length. It is accordingly an object of the present invention to provide such methods.

EP-A-0522814 discloses a method of forming a printhead from a plurality of PZT members by forming grooves therein.

In carrying out principles of the present invention, in accordance with a preferred embodiment thereof, a page wide piezoelectric ink jet printhead assembly is fabricated by a method of fabricating a page wide piezoelectric ink jet printhead, said method comprising the steps of:

providing a first series of piezoelectric body sections each having opposite sides and a width extending therebetween;

providing a second series of piezoelectric body sections each having opposite sides and a width extending therebetween,

the widths of said body sections in said first and second series thereof being substantially identical to one another;

poling said body sections in said first and second series thereof in widthwise directions;

intersecuring the poled first series of body sections in a side-to-side abutting relationship;

intersecuring the poled second series of body sections in a side-to-side abutting relationship;

attaching said first and second series of poled body sections to one another in a manner forming therefrom a first printhead body portion having parallel, essentially planar opposite first and second side surfaces between which aligned, generally planar side juncture areas of said first and second series of poled body sections transversely extend, and in which the polling directions of said first series of poled body sections are identically oriented, and the polling directions of said second series of poled body sections are identically oriented and extend oppositely to those of said first series of poled body sections;

providing a second printhead body portion having a

generally planar first side surface;

securing said first side surface of said first printhead body portion to said first side surface of said second printhead body portion;

forming a series of equally spaced, parallel grooves through said first printhead body portion, after its securement to said second printhead body portion, each of said grooves extending from said second side surface of said first printhead body portion to at least said first side surface thereof, with a first number of said grooves extending through and removing all of said side juncture areas of said first printhead body portion, and a second number of said grooves being interdigitated with said first number of said grooves, said grooves having open front and rear ends and open side portions extending between said open front and rear ends;

providing a third printhead body portion having a generally planar first side surface;

securing said first side surface of said third printhead body portion to said second side surface of said first printhead body portion in a manner such that said third printhead body portion extends across and covers said open side portions of said grooves;

securing a plate member to said first, second and third printhead body portions over said open front ends of said grooves, said plate member having a spaced series of ink discharge orifices formed therein and communicating with said open front ends of said grooves;

and sealing off said open rear ends of said grooves. The widths of the body sections are essentially identical, and are preferably not substantially greater than about 2.54cm (one inch).

A first number of the grooves extend through and remove all of the side juncture areas in the body section layers, and a second number of the grooves are interdigitated with the first number of grooves.

The grooves separate intersecured segments of the body sections which, in the finished printhead body, will define the piezoelectrically deflectable sidewall actuator sections that laterally bound the ink receiving channels along their lengths, have open front and rear ends and open side portions extending between their front and rear ends at the outer side surface of the two layer array of body sections. The grooves are preferably formed using a spaced series of saw cuts having a cut-to-cut pitch related in a predetermined manner to the original body section widths such that each of these widths is an even multiple of the saw cut pitch.

After the channel-defining grooves are formed, another nonpoled printhead body portion is secured to the outer side surface of the two layer body section array to close off the open sides of the groove, and a plate member is secured to the front side of the printhead body over the open front ends of the grooves. The plate member has a spaced series of ink discharge orifices formed therein and communicating with the front ends of the grooves. The open rear ends of the grooves are suitably sealed off, and electrical drive means are operatively connected to the actuator sidewall portions of the printhead body.

Due to the separate poling of only relatively small segments of the printhead body before it is assembled, and the placement of the saw-cut grooves, the printhead may be easily given a page width length without the problems typically associated with attempting to pole a unitary piezoelectric body portion of this overall length.

FIG. 1 is a simplified, somewhat schematic perspective view of a page wide piezoelectric ink jet printhead assembly embodying principles of the present invention;

FIG. 2 is an enlarged scale right end elevational view of the printhead assembly;

FIG. 3 is an enlarged scale top plan view of a right end portion of the printhead assembly;

FIG. 4 is an enlarged scale, highly schematic partial cross-sectional view through the printhead assembly taken along line 4-4 of FIG. 1; and

FIGS. 4A and 4B are enlarged scale, highly schematic cross-sectional views through the printhead assembly and sequentially illustrate, together with FIG. 4, a unique construction method of the present invention used to fabricate the printhead assembly.

Referring initially to FIGS. 1-4, the present invention provides a uniquely constructed page wide piezoelectric ink jet printhead assembly 10 having an elongated rectangular body portion 12. An elongated rectangular discharge orifice plate 14 is secured to and covers a front side surface of the body 12 and has a spaced series of small ink jet orifices 16 extending rearwardly therethrough into the interior of the printhead body 10 as later described.

From top to bottom as viewed in FIGS. 2 and 4, the printhead body 12 comprises intersecured elongated rectangular sections 18, 20, 22 and 24. As may best be seen in FIGS. 2 and 3, body sections 18, 20 and 22 are horizontally aligned with one another, and the bottom body section 24 extends rearwardly beyond the other body sections and has an exposed top side surface area 24. Body sections 18 and 24 are formed from a nonpoled piezoceramic material, preferably a PZT material, and body sections 20 and 22 are formed, as later described, from a poled piezoceramic material, preferably a PZT material.

Extending along the exposed top side surface 26 of the printhead body section 24 is a spaced series of parallel, electrically conductive surface traces 28. Each of the traces 28 longitudinally extends in a front-to-rear direction along the top side surface 26, with the front ends of the traces 28 being conductively connected to segments of the printhead body section 22 (see FIG. 4). The rear ends of the surface traces 28 are operatively

connected to a suitable electronic driver 30 mounted atop the body surface 26 rearwardly of the body sections 18, 20 and 22. The driver 30 is used to transmit electrical actuating signals to segments of the body section 22 to piezoelectrically cause ink, in droplet form, to be forwardly discharged from the orifices 16 as subsequently described herein.

Referring now to FIG. 4, a horizontally spaced series of elongated, parallel ink receiving channels 32 are formed within the printhead body 12, with each of the channels 32 longitudinally extending rearwardly from the orifice plate 14 and having a front end communicating with one of the ink discharge orifices 16. The channels 32 are horizontally interdigitated with a spaced series of internal sidewall actuator sections 34, with each channel being laterally bounded along its length by a horizontally opposing pair of sidewall actuator sections 34.

The rear ends of the channels 34 communicate with an ink receiving manifold 35 (see FIG. 2) formed within the upper printhead body section. This internal manifold, in turn, is communicated with a suitable ink supply vessel 36 (see FIG. 1) via an ink delivery tube 38.

When it is desired to discharge ink, in droplet form, from one of the channels 32 through its associated discharge orifice 16 electrical driving voltage signals from the driver 30 are transmitted, via the appropriate pair of surface traces 28, to the opposed pair of sidewall actuator sections 34 that bound the channel. The receipt of these voltage signals causes the two sidewall actuator sections to piezoelectrically deflect into the channel, thereby constricting the channel and causing ink therein to be forced outwardly through its associated discharge orifice 16.

As mentioned previously, the printhead assembly 10 is a "page wide" assembly, meaning that it is sized to longitudinally extend along essentially the entire width of a print medium sheet passing through the printer and remain stationary during the printing process, as opposed to having a width much less than the paper width and being shuttled back and forth across the sheet as it traverses the printer. Representatively, the length of the illustrated printhead assembly 10 is about 21.6cm (8.5"). However, its length could be made longer or shorter if desired.

Heretofore the fabrication of piezoelectric printhead assemblies in page wide lengths has been difficult if not impossible due to the poling width limitations inherent in piezoelectric sections used to build the printhead body. As a practical matter, the voltage required to properly pole a piezoelectric body section becomes unacceptably high as the width of the section, in the poling direction, is increased much beyond an inch or so. Additionally, attempts to pole a piezoelectric body section having a width greater than about one inch can result in cracking of segments of the poled section when they are later piezoelectrically deflected.

These problems are overcome, in a manner providing the piezoelectric printhead assembly 10 with its advantageous page width length depicted in FIG. 1, using a unique printhead body fabrication technique which will now be described in conjunction with FIGS. 4-4B.

According to principles of the present invention, to form the printhead body sections 20 and 22 two series of separate, rectangularly configured piezoceramic blocks 20a and 22a (see FIG. 4A) are provided. Each of the blocks 20a,22a has a front-to-rear length identical to the printhead body sections 20 and 22, and a horizontal width W (as viewed in FIG. 4A) of not more than about one inch. The separate piezoceramic blocks 20a are then suitably poled in directions X_1 parallel to their widths, and the separate piezoceramic blocks 22a are suitably poled in directions X_2 parallel to their widths.

The poled blocks 20a,22a are then secured to one another, and to the top side of the unpoled piezoceramic printhead body section or substrate 24, in the arrangement illustrated in FIG. 4, using a suitable electrically conductive epoxy material. In such arrangement the blocks 22a extend across the top side of the body section 24 in a side-to-side orientation with their poling directions X_2 being identical to one another, and the blocks 20a extend across the top sides of the blocks 22a with their poling directions X_1 extending oppositely to those of the blocks 22a. Furthermore, the side-to-side joint lines of the block series 20a,22a are horizontally aligned with one another in a manner such that in the intersecured array of blocks 20a,22a a series of vertical joint lines 40, horizontally spaced apart along the left-to-right length of the partially assembled printhead body, are formed.

Next, as schematically depicted in FIG. 4B, a horizontally spaced series of vertical saw cuts 32a (that ultimately define in the finished printhead body the interior ink receiving channels 32 shown in FIG. 4) are made downwardly through the vertically intermediate printhead body portion defined by the intersecured series of blocks 20a and 22a, and a relatively short distance into the top side of the bottom printhead body section 24.

As shown in FIG 4B, the resulting grooves formed by the saw cuts 32a also horizontally separate the intersecured series of blocks 20a and 22a into horizontally shorter segments 20b and 22b that are vertically stacked in pairs, each such stacked pair of segments 20b,22b defining one of the internal sidewall actuator sections 34 as indicated in FIG. 4.

In accordance with an important aspect of the present invention, the pitch P of the saw cuts 32a (i.e., the identical horizontal spacing between each adjacent pair of saw cuts) is selected in a manner such that the block width W is a predetermined even multiple of the pitch P, and the series of saw cuts 32a is horizontally oriented in a manner such that a saw cut 32a extends vertically through each of the block joints 40 as illustrated in FIG. 4B. In this manner, none of the sidewall actuator sections 34 (see FIG. 4) has a vertical joint therein which could potentially weaken the sidewall section in its lateral deflection mode or electrically alter its opera-

tion.

After the saw cuts 32a are formed, the upper printhead body section 18 is adhesively bonded to the upper sides of the block segments 20b (see FIG. 4), thereby closing off the top sides of the channels 32, the orifice plate 14 (see FIG. 1) is operatively installed, and the open rear ends of the channels 32 are appropriately sealed off.

Claims

1. A method of fabricating a page wide piezoelectric ink jet printhead (16), said method comprising the steps of:

   providing a first series (20) of piezoelectric body sections each having opposite sides and a width extending therebetween;
   providing a second series (22) of piezoelectric body sections each having opposite sides and a width extending therebetween,
   the widths of said body sections in said first and second series thereof being substantially identical to one another;
   poling said body sections in said first and second series thereof in widthwise directions;
   intersecuring the poled first series of body sections in a side-to-side abutting relationship;
   intersecuring the poled second series of body sections in a side-to-side abutting relationship;
   attaching said first and second series of poled body sections to one another in a manner forming therefrom a first printhead body portion having parallel, essentially planar opposite first and second side surfaces between which aligned, generally planar side juncture areas of said first and second series of poled body sections transversely extend, and in which the polling directions of said first series of poled body sections are identically oriented, and the polling directions of said second series of poled body sections are identically oriented and extend oppositely to those of said first series of poled body sections;
   providing a second printhead body portion (24) having a generally planar first side surface;
   securing said first side surface of said first printhead body portion to said first side surface of said second printhead body portion;
   forming a series of equally spaced, parallel grooves (32a) through said first printhead body portion, after its securement to said second printhead body portion, each of said grooves extending from said second side surface of said first printhead body portion to at least said first side surface thereof, with a first number of said grooves extending through and removing all of said side juncture areas of said first printhead body portion, and a second number of said grooves being interdigitated with said first number of said grooves, said grooves having open front and rear ends and open side portions extending between said open front and rear ends;
   providing a third printhead body portion (18) having a generally planar first side surface;
   securing said first side surface of said third printhead body portion to said second side surface of said first printhead body portion in a manner such that said third printhead body portion extends across and covers said open side portions of said grooves;
   securing a plate member (14) to said first, second and third printhead body portions over said open front ends of said grooves, said plate member having a spaced series of ink discharge orifices formed therein and communicating with said open front ends of said grooves;
   and sealing off said open rear ends of said grooves.

2. The method of Claim 1 wherein:
   said forming step is carried out by forming a spaced series of parallel saw cuts in said first printhead body portion.

3. The method of Claim 2 wherein:
   said series of saw cuts have a cut-to-cut pitch, and said method further comprises the step of relating the widths of said body sections in said first and second series thereof in a manner such that said widths are equal multiples of said saw cut pitch.

4. The method of Claim 1 wherein:
   said forming step is carried out in a manner extending said grooves (32a) at least a short distance into said second printhead body section (24).

5. The method of Claim 1 wherein:
   said body sections in said first (20) and second (22) series thereof are formed from a piezoceramic material, and said intersecuring and attaching steps are performed using an electrically conductive adhesive material.

6. The method of Claim 1 wherein:
   the widths of said body sections in said first (20) and second (22) series thereof are not substantially greater than about 25.4mm (one inch).

Patentansprüche

1. Verfahren zum Herstellen eines seitenbreiten piezoelektrischen Tintenstrahldruckkopfes (16), wobei das Verfahren die folgenden Schritte umfaßt:

Schaffung einer ersten Reihe (20) piezoelektrischer Körperabschnitte mit jeweils gegenüberliegenden Seiten und einer zwischen ihnen verlaufenden Breite;

Schaffung einer zweiten Reihe (22) piezoelektrischer Körperabschnitte mit jeweils gegenüberliegenden Seiten und einer zwischen ihnen verlaufenden Breite;

wobei die Breite der Körperabschnitte in der ersten und der zweiten Reihe im wesentlichen identisch ist;

Polung der Körperabschnitte in der ersten und zweiten Reihe in Breitenrichtung;

Befestigung der gepolten ersten Reihe seitlich aneinanderliegender Körperabschnitte miteinander;

Befestigung der gepolten zweiten Reihe seitlich aneinanderliegender Körperabschnitte miteinander;

Zusammenfügen der ersten und der zweiten Reihe gepolter Körperabschnitte derart, daß daraus ein erster Teil des Druckkopfkörpers mit parallelen, weitgehend planaren, gegenüberliegenden ersten und zweiten Seitenflächen entsteht, zwischen denen gefluchtete, allgemein planare Fugen der ersten und der zweiten Reihe gepolter Körperabschnitte quer verlaufen, und in dem die Polrichtungen der ersten Reihe gepolter Körperabschnitte identisch sind sowie die Polrichtungen der zweiten Reihe gepolter Körperabschnitte identisch und zu denen der ersten Reihe gepolter Körperabschnitte entgegengesetzt sind;

Schaffung eines zweiten Teils des Druckkopfkörpers (24) mit einer allgemein planaren ersten Seitenfläche;

Befestigung der ersten Seitenfläche des ersten Teils des Druckkopfkörpers an der ersten Seitenfläche des zweiten Teils des Druckkopfkörpers;

Ausbildung einer Reihe gleichmäßig beabstandeter, paralleler Nuten (32a) durch den ersten Teil des Druckkopfkörpers nach dessen Anbringung an dem zweiten Teil des Druckkopfkörpers, wobei sich die Nuten von der zweiten Seitenfläche des ersten Teils des Druckkopfkörper mindestens bis zu dessen erster Seitenfläche erstrecken, wobei eine erste Anzahl der Nuten durch alle Fugen des ersten Teils des Druckkopfkörpers verläuft und selbige entfernt, und eine zweite Anzahl der Nuten zu der ersten Anzahl von Nuten parallelgeschaltet ist, wobei die Nuten ein offenes Vorder- und Hinterende sowie eine offene Seite zwischen dem offenen Vorder- und Hinterende haben;

Schaffung eines dritten Teils des Druckkopfkörpers (18) mit einer allgemein planaren ersten Seitenfläche;

Befestigung der ersten Seitenfläche des dritten Teils des Druckkopfkörpers an der zweiten Seitenfläche des ersten Teils des Druckkopfkörpers derart, daß der dritte Teil des Druckkopfkörpers quer über die offene Seiten der Nuten verläuft und selbige abdeckt;

Befestigung eines Plattenelements (14) an dem ersten, zweiten und dritten Teil des Druckkopfkörpers über den offenen Vorderenden der Nuten, wobei das Plattenelement eine beabstandete Reihe von Tintenausgabeöffnungen aufweist, die mit den offenen Vorderenden der Nuten verbunden ist;

und Verschließen der offenen Hinterenden der Nuten.

2. Verfahren nach Anspruch 1, wobei:

der Schritt des Ausbildens durch das Bilden einer beabstandeten Reihe paralleler Sägeschnitte in den ersten Druckkopfkörperabschnitt erfolgt.

3. Verfahren nach Anspruch 2, wobei:

die Reihe der Sägeschnitte einen Abstand zwischen den einzelnen Einschnitten aufweist und das Verfahren weiterhin den Schritt umfaßt, in dem die Breite der Körperabschnitte in der ersten und der zweiten Reihe derart zu ihm ins Verhältnis gesetzt werden, daß die Breiten ein gleiches Vielfaches des Abstandes zwischen den Sägeschnitten darstellen.

4. Verfahren nach Anspruch 1, wobei:

der Schritt des Ausbildens so erfolgt, daß die Nuten (32a) zumindest ein kurzes Stück in den zweiten Druckkopfkörperabschnitt (24) hineinreichen.

5. Verfahren nach Anspruch 1, wobei:

die Körperabschnitte in der ersten (20) und der zweiten (22) Reihe aus einem piezokeramischen Werkstoff hergestellt werden und die Schritte des Anbringens und Befestigens aneinander mit Hilfe eines elektrisch leitenden Klebstoffs erfolgen.

6. Verfahren nach Anspruch 1, wobei:

die Breite der Körperabschnitte in der ersten (20) und der zweiten (22) Reihe nicht wesentlich größer als etwa 25,4 mm (ein Inch) ist.

Revendications

1. Procédé pour fabriquer une tête d'impression à jet d'encre (16), possédant la largeur d'une page, ledit procédé comprenant les étapes consistant à :

prévoir une première série (20) de sections piézoélectriques d'un corps possédant chacune des côtés opposés et une largeur entre ces côtés;

prévoir une seconde série (22) de sections piézoélectriques du corps possédant chacun des côtés opposés et une largeur entre ces côtés,

les largeurs desdites sections desdites première et seconde séries de sections du corps étant essentiellement identiques;

polariser lesdites sections desdites première et seconde séries de sections du corps dans le sens de la largeur;

fixer entre elles la première série polarisée de sections du corps dans une relation d'aboutement côte-à-côte;

fixer entre elles la seconde série polarisée de sections du corps dans une relation d'aboutement côte-à-côte,

attacher lesdites première et seconde séries de sections polarisées du corps l'une à l'autre de manière à former, à partir de là, une première partie de corps de la tête d'impression possédant des première et seconde surfaces latérales opposées parallèles et essentiellement planes, entre lesquelles s'étendent transversalement des zones latérales de jonction alignées et ayant une configuration générale plane, desdites première et seconde séries de sections polarisées du corps, et les directions de polarisation de ladite première série de sections polarisées de corps étant orientées de la même manière, et les directions de polarisation de ladite seconde série de sections polarisées du corps étant orientées de la même manière et s'étendant dans un sens opposé à celui de ladite première série de sections polarisées du corps;

prévoir une seconde partie (24) du corps de la tête d'impression, possédant une première surface latérale ayant une configuration générale plane;

fixer ladite première surface latérale de ladite première partie de corps de la tête d'impression à ladite première surface latérale de ladite seconde partie du corps de la tête d'impression;

former une série de rainures parallèles également espacées (32a) dans ladite première partie du corps de la tête d'impression après sa fixation à ladite seconde partie du corps de la tête d'impression, chacune desdites rainures s'étendant à partir de ladite seconde surface latérale de ladite première partie du corps de la tête d'impression au moins jusqu'à ladite première surface latérale de cette partie, un premier nombre desdites rainures s'étendant à travers et supprimant la totalité desdites zones de jonction latérale de ladite première partie du corps de la tête d'impression, et un second nombre desdites rainures étant interdigité avec ledit premier nombre desdites rainures, lesdites rainures comportant des extrémités avant et arrière ouvertes et des parties latérales ouvertes s'étendant entre lesdites extrémités avant et arrière ouvertes;

prévoir une troisième partie (18) du corps de la tête d'impression possédant une première surface latérale ayant une configuration générale plane; fixer ladite première surface latérale de ladite troisième partie du corps de la tête d'impression à ladite seconde surface latérale de ladite première partie du corps de la tête d'impression de telle manière que ladite troisième partie du corps de la tête d'impression s'étend en travers desdites parties latérales ouvertes desdites rainures et les recouvre;

fixer un élément en forme de plaque (14) auxdites première, seconde et troisième parties du corps de la tête d'impression au-dessus desdites extrémités avant ouvertes desdites rainures, ledit élément en forme de plaque comportant une série d'orifices espacés de décharge de l'encre, qui sont formés dans cet élément et communiquent avec lesdites extrémités avant ouvertes desdites rainures; et

fermer de façon étanche lesdites extrémités arrière ouvertes desdites rainures.

2. Procédé selon la revendication 1, selon lequel :

ladite étape de formation est exécutée par formation d'une série de découpes parallèles, réalisées à la scie, dans ladite première partie du corps de la tête d'impression.

3. Procédé selon la revendication 2, selon lequel :

ladite série de découpes, réalisées à la scie, possède un pas entre découpes, et ledit procédé comprend en outre l'étape consistant à associer les largeurs desdites sections du corps dans lesdites première et seconde séries de sections de telle sorte que lesdites largeurs sont des multiples égaux dudit pas des découpes réalisées à la scie.

4. Procédé selon la revendication 1, selon lequel :

ladite étape de formation est exécutée d'une manière qui prolonge lesdites rainures (32a) au moins sur une courte distance dans ladite seconde section (24) du corps de la tête d'impression.

5. Procédé selon la revendication 1, selon lequel :

lesdites sections du corps dans ladite première série (20) et ladite seconde série (22) de sections du corps sont formées d'un matériau piézocéramique, et que lesdites étapes de fixation réciproque et de rattachement sont exécutées en utilisant un matériau adhésif électriquement conducteur.

6. Procédé selon la revendication 1, selon lequel :

les largeurs desdites sections du corps dans ladite première série (20) et ladite seconde série

(22) de sections du corps ne sont pas nettement supérieures à environ 25,4 mm (un pouce).

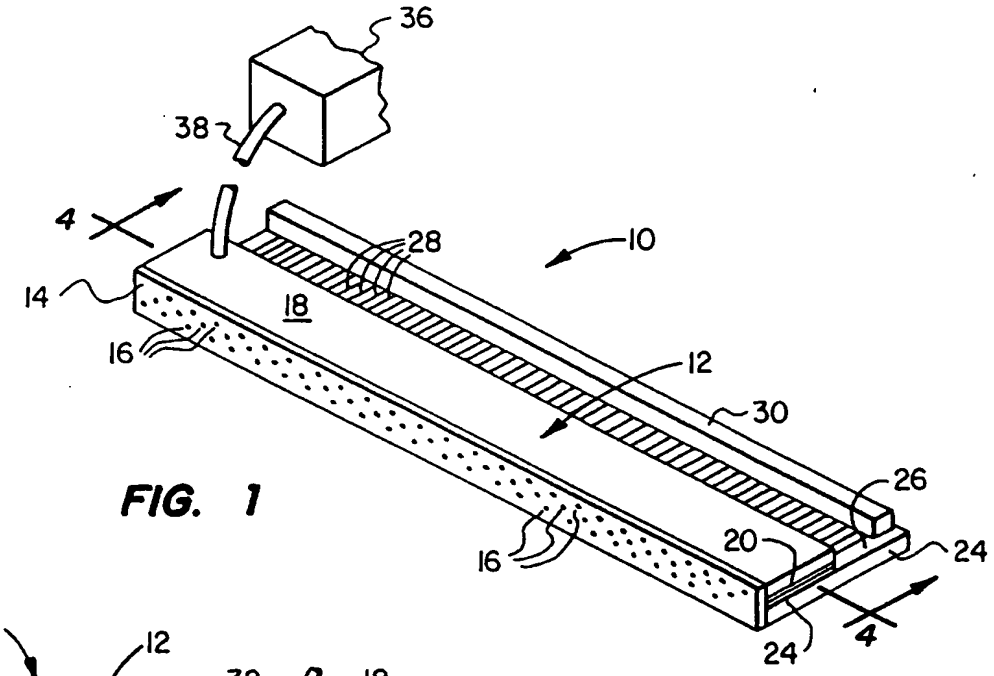

FIG. 1

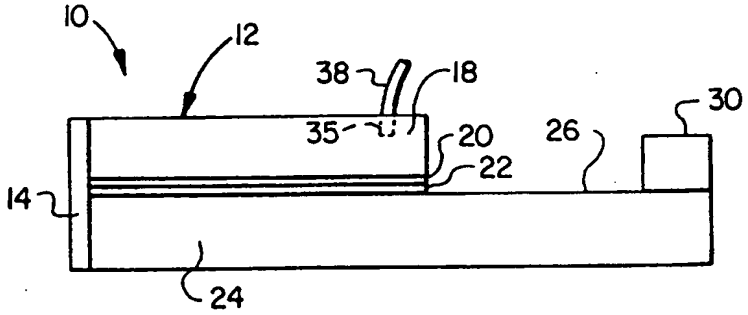

FIG. 2

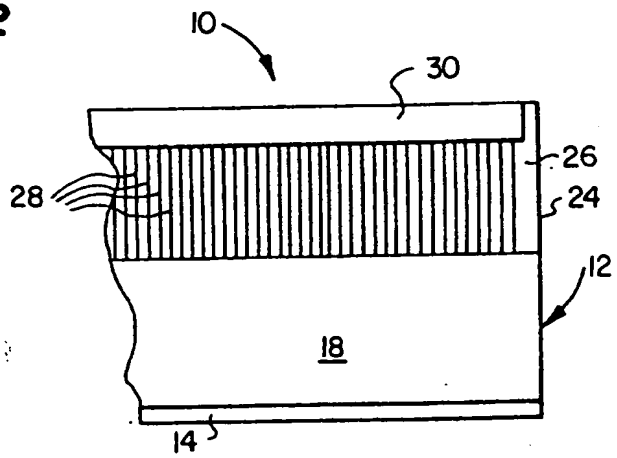

FIG. 3

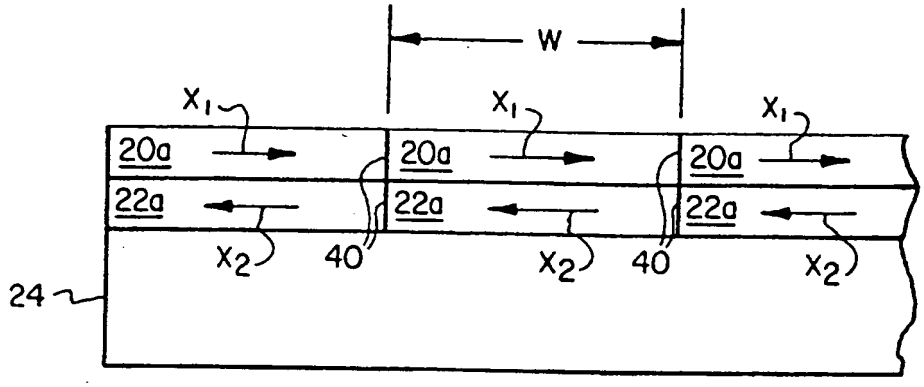

FIG. 4A

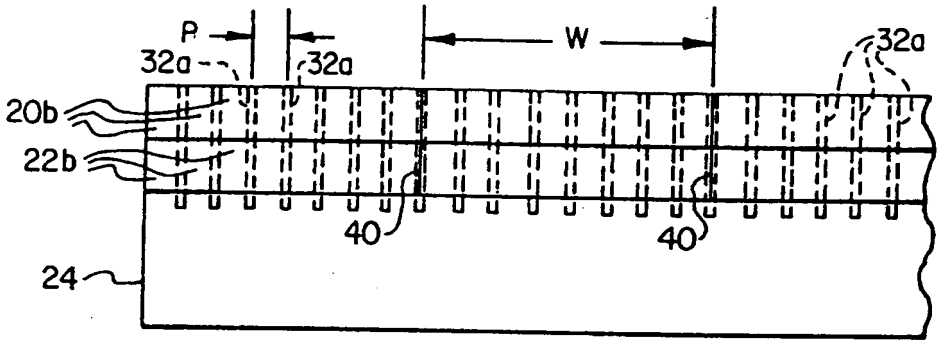

FIG. 4B

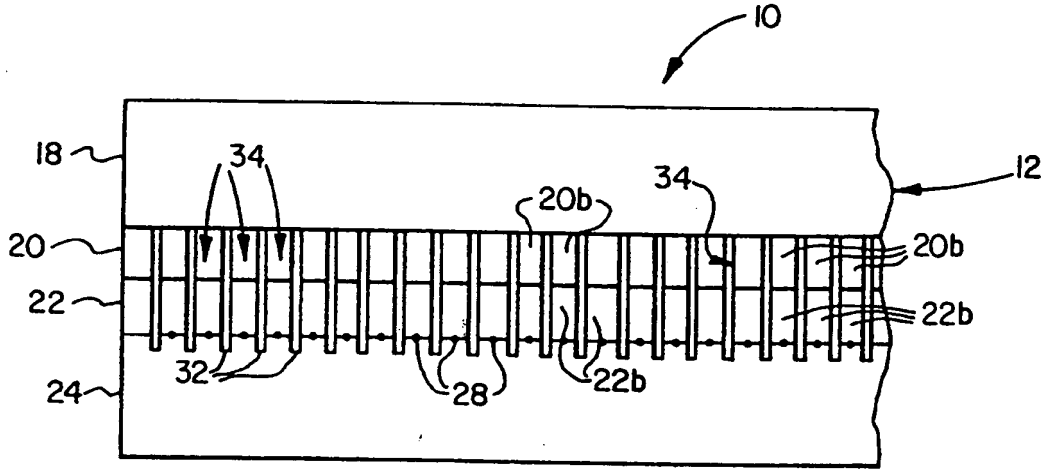

FIG. 4